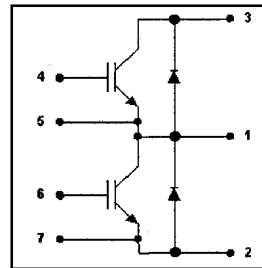


Features

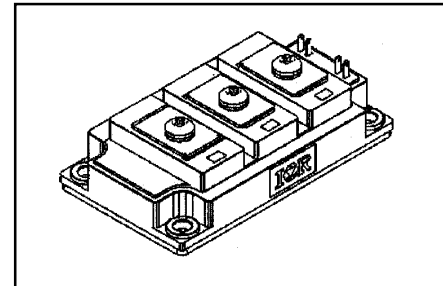
- Generation 4 IGBT technology
- UltraFast: Optimized for high operating frequencies 8-40 kHz in hard switching, >200 kHz in resonant mode
- Very low conduction and switching losses
- HEXFRED™ antiparallel diodes with ultra- soft recovery
- Industry standard package
- UL approved



$V_{CES} = 600V$
 $V_{CE(on) typ.} = 1.70V$
 @ $V_{GE} = 15V, I_C = 400A$

Benefits

- Increased operating efficiency
- Direct mounting to heatsink
- Performance optimized for power conversion: UPS, SMPS, Welding
- Lower EMI, requires less snubbing



Absolute Maximum Ratings

| | Parameter | Max. | Units |
|--------------------------|--|-------------|-------|
| V_{CES} | Collector-to-Emitter Voltage | 600 | V |
| $I_C @ T_C = 25^\circ C$ | Continuous Collector Current | 400 | A |
| I_{CM} | Pulsed Collector Current① | 800 | |
| I_{LM} | Peak Switching Current② | 800 | |
| I_{FM} | Peak Diode Forward Current | 800 | |
| V_{GE} | Gate-to-Emitter Voltage | ± 20 | V |
| V_{ISOL} | RMS Isolation Voltage, Any Terminal To Case, $t = 1 \text{ min}$ | 2500 | W |
| $P_D @ T_C = 25^\circ C$ | Maximum Power Dissipation | 1250 | |
| $P_D @ T_C = 85^\circ C$ | Maximum Power Dissipation | 650 | |
| T_J | Operating Junction Temperature Range | -40 to +150 | °C |
| T_{STG} | Storage Temperature Range | -40 to +125 | |

Thermal / Mechanical Characteristics

| | Parameter | Typ. | Max. | Units |
|-----------------|--|------|------|-------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case - IGBT | — | 0.10 | °C/W |
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case - Diode | — | 0.20 | |
| $R_{\theta CS}$ | Thermal Resistance, Case-to-Sink - Module | 0.1 | — | |
| | Mounting Torque, Case-to-Heatsink | — | 4.0 | N·m |
| | Mounting Torque, Case-to-Terminal 1, 2 & 3③ | — | 3.0 | |
| | Weight of Module | 400 | — | g |

Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|--------------------------------|---|------|------|------|----------------------|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage | 600 | — | — | V | $V_{GE} = 0V, I_C = 1mA$ |
| $V_{CE(on)}$ | Collector-to-Emitter Voltage | — | 1.7 | 2.4 | | $V_{GE} = 15V, I_C = 400A$ |
| | | — | 1.8 | — | | $V_{GE} = 15V, I_C = 400A, T_J = 125^\circ\text{C}$ |
| $V_{GE(th)}$ | Gate Threshold Voltage | 3.0 | — | 6.0 | | $I_C = 2.5mA$ |
| $\Delta V_{GE(th)}/\Delta T_J$ | Temperature Coeff. of Threshold Voltage | — | -11 | — | mV/ $^\circ\text{C}$ | $V_{CE} = V_{GE}, I_C = 2.5mA$ |
| g_{fe} | Forward Transconductance ④ | — | 481 | — | S | $V_{CE} = 25V, I_C = 400A$ |
| I_{CES} | Collector-to-Emitter Leaking Current | — | — | 2.0 | mA | $V_{GE} = 0V, V_{CE} = 600V$ |
| | | — | — | 20 | | $V_{GE} = 0V, V_{CE} = 600V, T_J = 125^\circ\text{C}$ |
| V_{FM} | Diode Forward Voltage - Maximum | — | 3.7 | — | V | $I_F = 400A, V_{GE} = 0V$ |
| | | — | 3.6 | — | | $I_F = 400A, V_{GE} = 0V, T_J = 125^\circ\text{C}$ |
| I_{GES} | Gate-to-Emitter Leakage Current | — | — | 500 | nA | $V_{GE} = \pm 20V$ |

Dynamic Characteristics - $T_J = 125^\circ\text{C}$ (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|------------------|--|------|-------|------|-------|--|
| Q_g | Total Gate Charge (turn-on) | — | 1806 | 2709 | nC | $V_{CC} = 400V$ |
| Q_{ge} | Gate - Emitter Charge (turn-on) | — | 251 | 376 | | $I_C = 270A, V_{GE} = 15V$ |
| Q_{gc} | Gate - Collector Charge (turn-on) | — | 612 | 918 | | $T_J = 25^\circ\text{C}$ |
| $t_{d(on)}$ | Turn-On Delay Time | — | 1033 | — | ns | $R_{G1} = 15\Omega, R_{G2} = 0\Omega,$ |
| t_r | Rise Time | — | 335 | — | | $I_C = 400A$ |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 688 | — | | $V_{CC} = 360V$ |
| t_f | Fall Time | — | 225 | — | | $V_{GE} = \pm 15V$ |
| E_{on} | Turn-On Switching Energy | — | 26 | — | mJ | |
| $E_{off(1)}$ | Turn-Off Switching Energy | — | 48 | — | | |
| $E_{ts(1)}$ | Total Switching Energy | — | 74 | 89 | | |
| C_{ies} | Input Capacitance | — | 40136 | — | pF | $V_{GE} = 0V$ |
| C_{oes} | Output Capacitance | — | 2509 | — | | $V_{CC} = 30V$ |
| C_{res} | Reverse Transfer Capacitance | — | 522 | — | | $f = 1\text{ MHz}$ |
| t_{rr} | Diode Reverse Recovery Time | — | 232 | — | ns | $I_C = 400A$ |
| I_{rr} | Diode Peak Reverse Current | — | 141 | — | | $R_{G1} = 15\Omega$ |
| Q_{rr} | Diode Recovery Charge | — | 16292 | — | nC | $R_{G2} = 0\Omega$ |
| $di_{(rec)M}/dt$ | Diode Peak Rate of Fall of Recovery During t_b | — | 1641 | — | | $V_{CC} = 360V$ $di/dt = 1300A/\mu s$ |

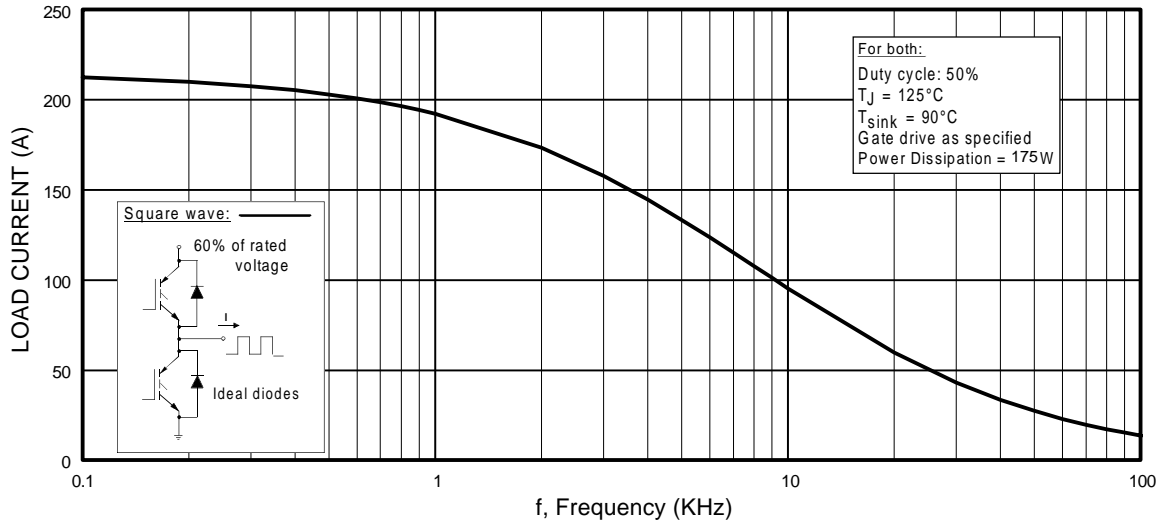


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

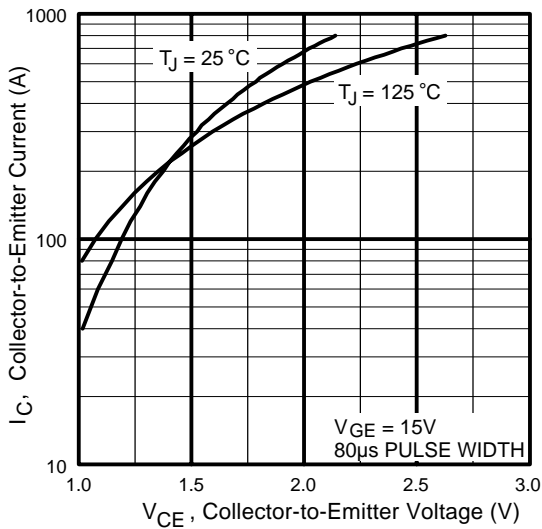


Fig. 2 - Typical Output Characteristics

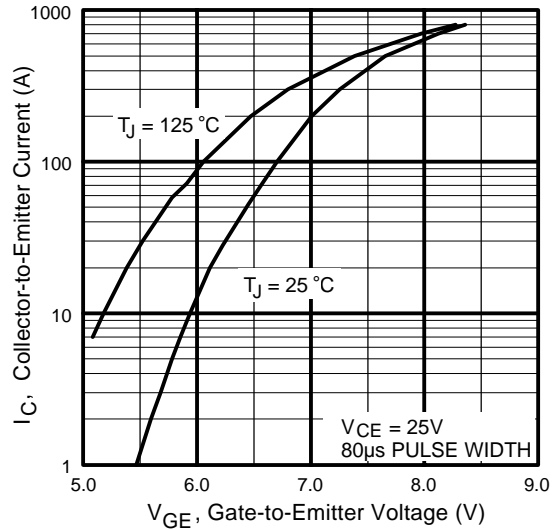


Fig. 3 - Typical Transfer Characteristics

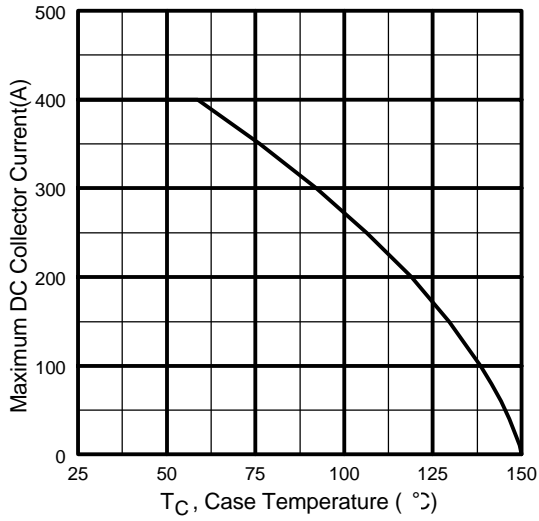


Fig. 4 - Maximum Collector Current vs. Case Temperature

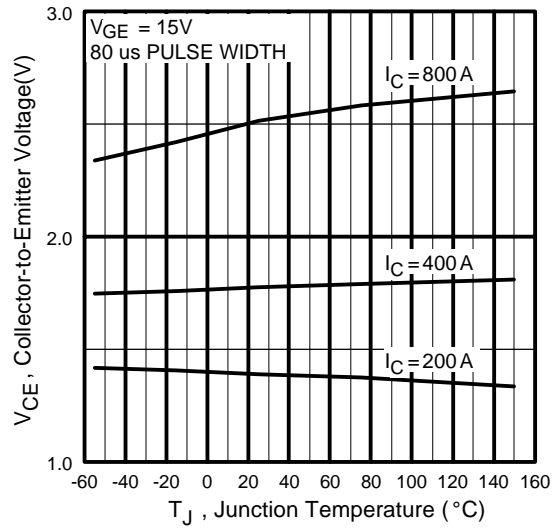


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

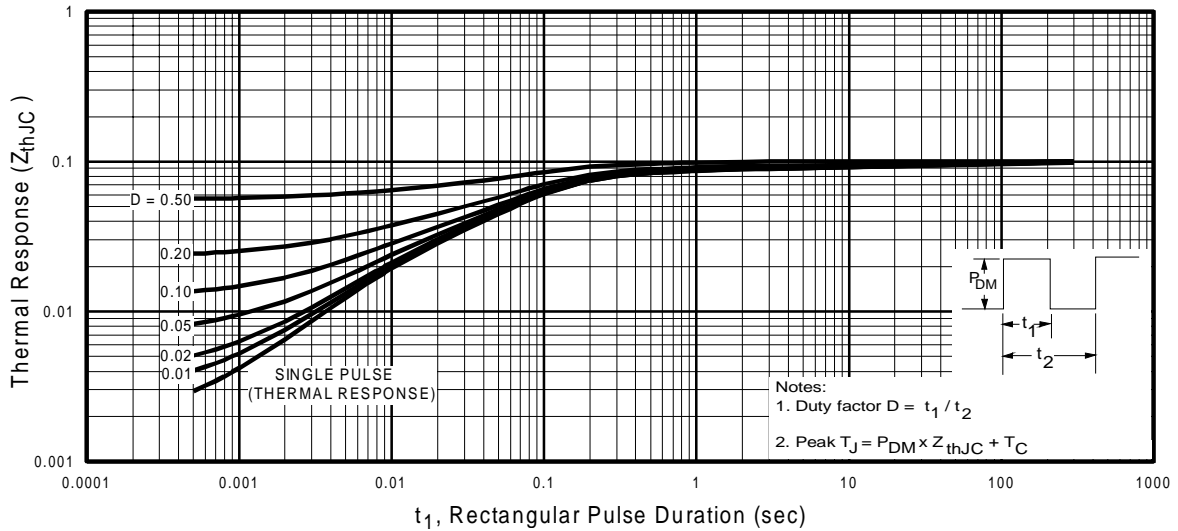


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

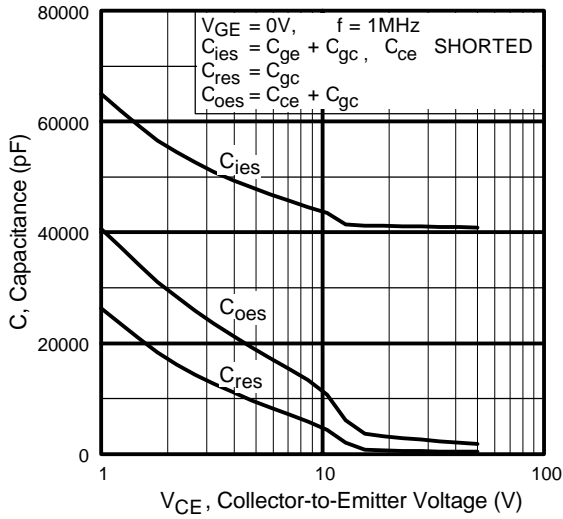


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

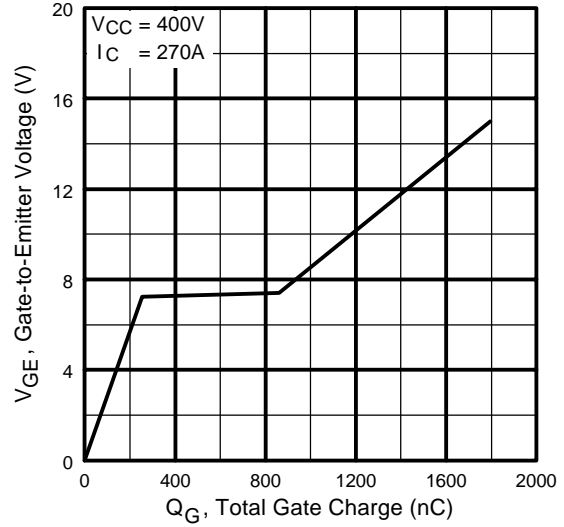


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

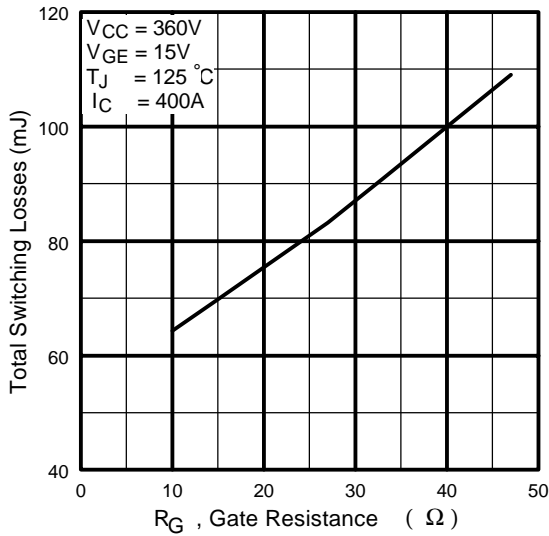


Fig. 9 - Typical Switching Losses vs. Gate Resistance

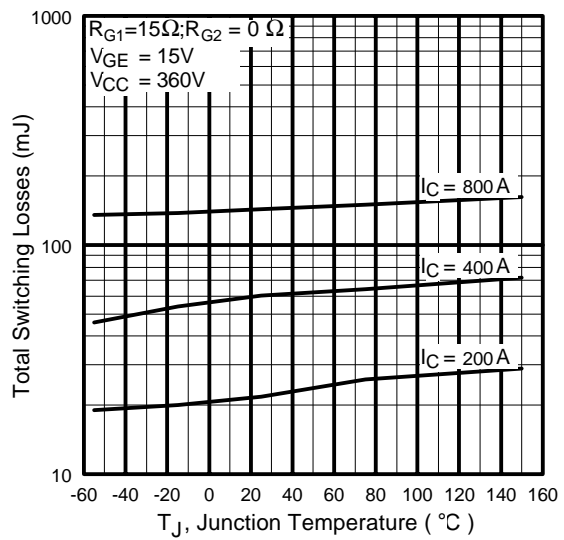


Fig. 10 - Typical Switching Losses vs. Junction Temperature

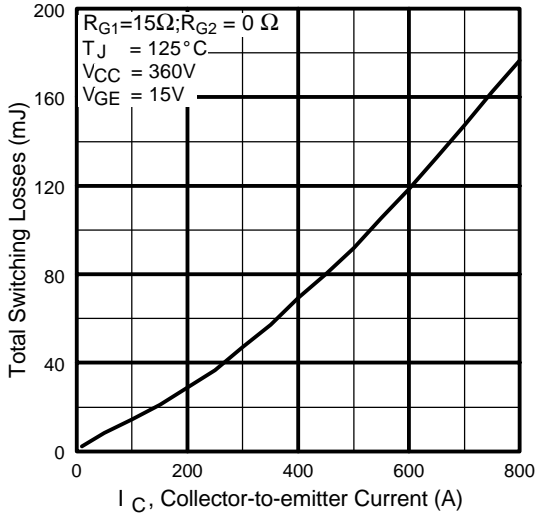


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

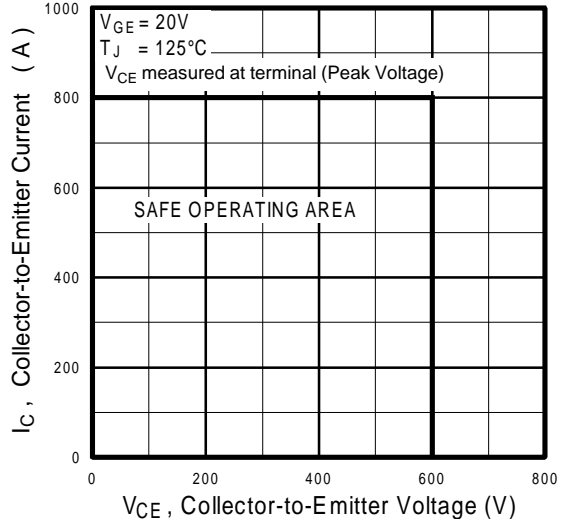


Fig. 12 - Reverse Bias SOA

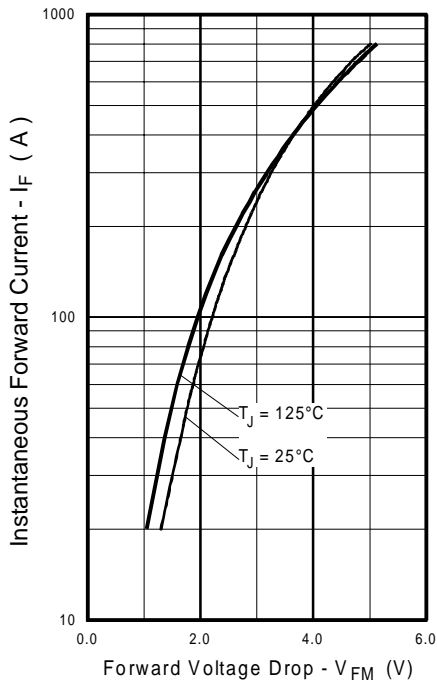


Fig. 13 - Typical Forward Voltage Drop vs. Instantaneous Forward Current

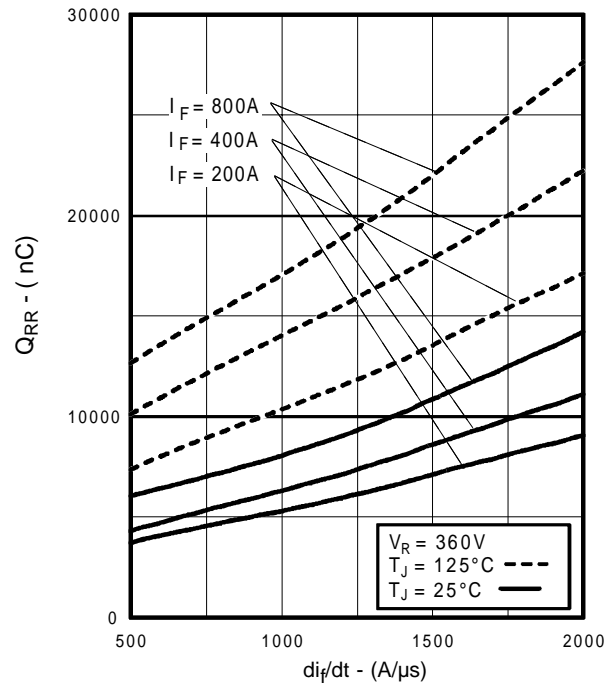


Fig. 14 - Typical Stored Charge vs. di/dt

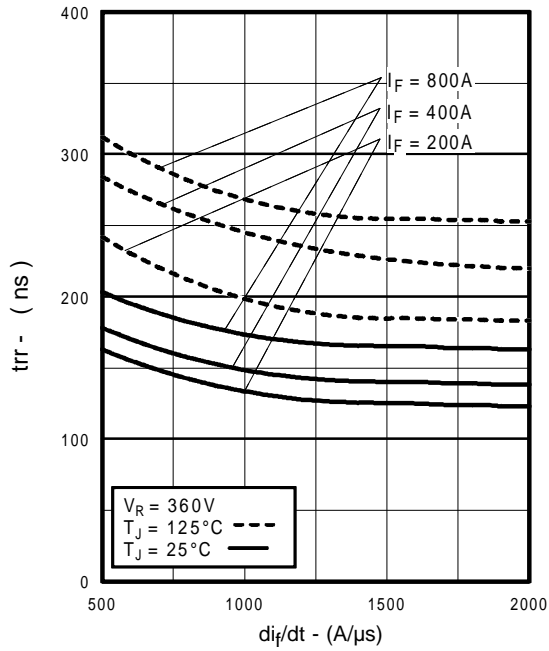


Fig. 15 - Typical Reverse Recovery vs. di_f/dt

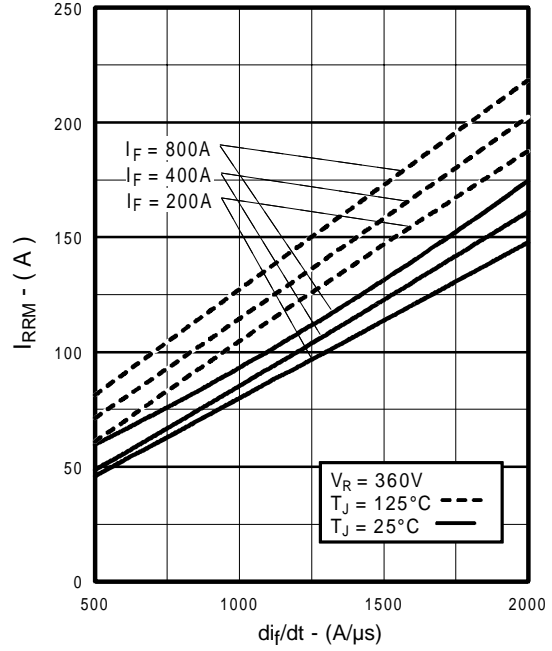


Fig. 16 - Typical Recovery Current vs. di_f/dt

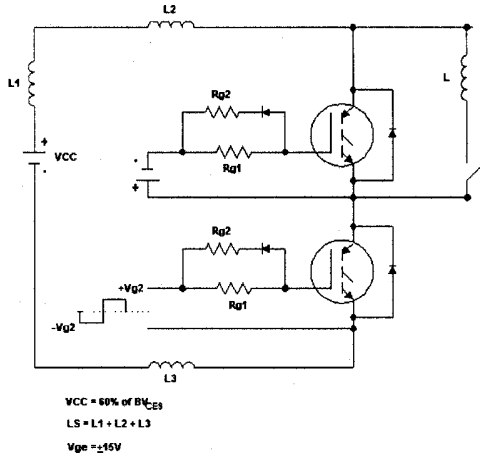


Fig. 17a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

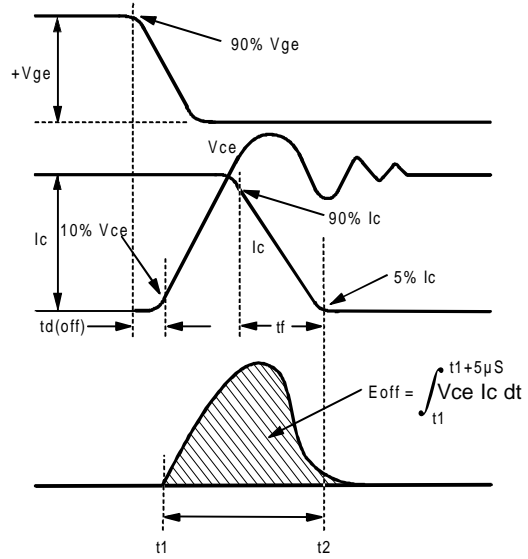


Fig. 17b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

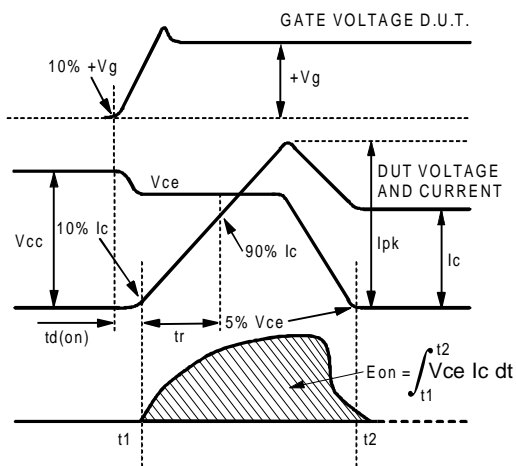


Fig. 17c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

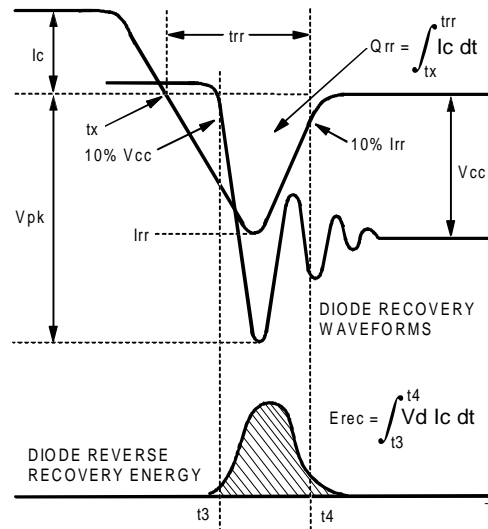


Fig. 17d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

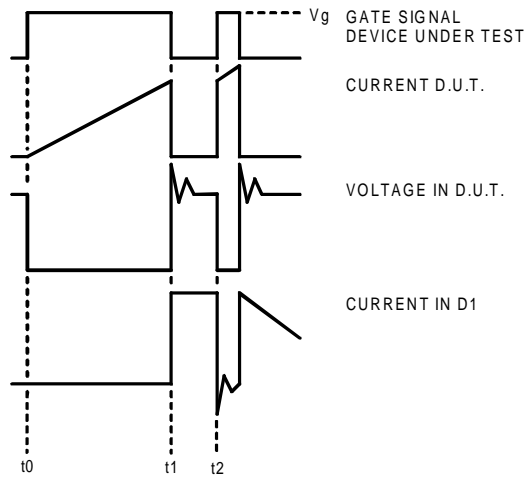


Figure 17e. Macro Waveforms for Figure 18a's Test Circuit

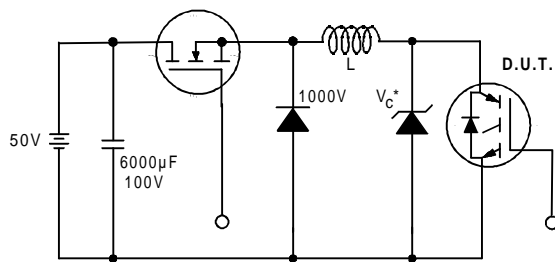


Figure 18. Clamped Inductive Load Test Circuit

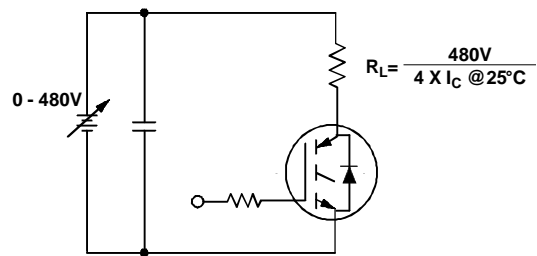


Figure 19. Pulsed Collector Current Test Circuit

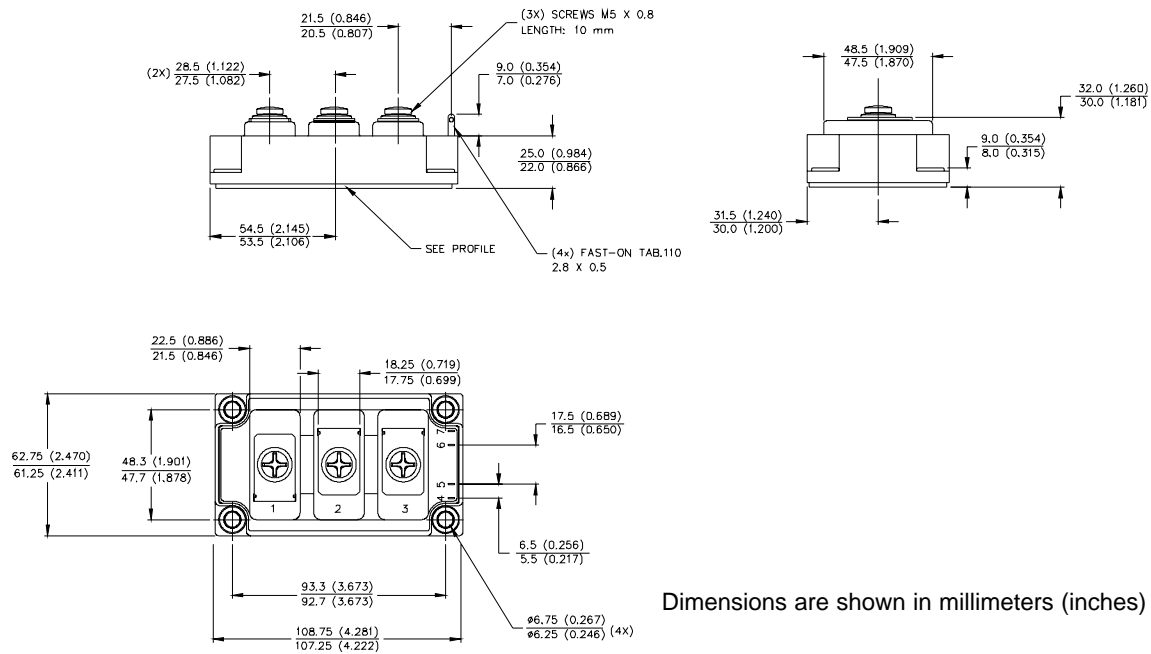
GA400TD60U

International
IR Rectifier

Notes:

- ① Repetitive rating; $V_{GE} = 20V$, pulse width limited by max. junction temperature.
- ② See fig. 17
- ③ For screws M5x0.8
- ④ Pulse width 50 μ s; single shot.

Case Outline — DOUBLE INT-A-PAK



Dimensions are shown in millimeters (inches)

International
IR Rectifier

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